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Award paper

Early results of primary Birmingham hip resurfacing using a hybrid metal-on-metal couple

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INTRODUCTION

The association between high volumetric wear, polyethylene particulate debris, osteolysis and loosening in total hip arthroplasty in young patients is well recognised and understood. This has resulted in an interest in alternative bearings, particularly in young and active patients. At our service, since the year 2000, only alumina ceramic bearings or metal-on-metal bearings are used in patients under the age of 75.

From September 1998 till February 2002 we performed 310 metal-on-metal Birmingham hip resurfacings. This prosthesis is becoming more and more widely used all over the world but mainly in Great Britain. The history of failures with the Charnley teflon-on-teflon and the Wagner metal-on-polyethylene prostheses makes resurfacing very controversial.

The results achieved with a new metal-on-metal resurfacing have not been published yet.

Theoretical advantages are less bone destruction, less bone resection, normal femoral loading, avoidance of stress shielding, maximum proprioceptive feedback and restoration of normal anatomy. In addition reduced risk of dislocation, less leg lengthening and easier revision should convince us to perform metal-on-metal resurfacing.

With the introduction of the Birmingham hip resurfacing prosthesis and a refined instrumentation it should be possible to avoid the problems of the earlier designs. The aim of our study is to evaluate the performance of this prosthesis in young patients and to prove that good instrumentation can provide good placement of the prosthesis.

The clinical results are excellent; none of the early problems associated with the Wagner resurfacing (metal-on-polyethylene) are encountered.

MATERIALS AND METHODS

Of the 310 resurfacing prostheses (which were all followed prospectively) 200 cases were scored clinically and functionally. In all cases the Birmingham hip resurfacing (Midland Medical Technologies) was utilised.

Through a posterior approach, slightly more extended than a standard posterior approach, the insertion of the gluteus maximus tendon is fully released to allow easy anterior displacement of the femur and femoral head to perform the acetabular procedure.

The chrome cobalt cup has a cast-in porous surface treated with hydroxyapatite, which is introduced as a pressfit component (Fig. 1). Additional screw fixation is possible using the dysplasia device with two

Fig. 1 - *Birmingham hip resurfacing prosthesis.*

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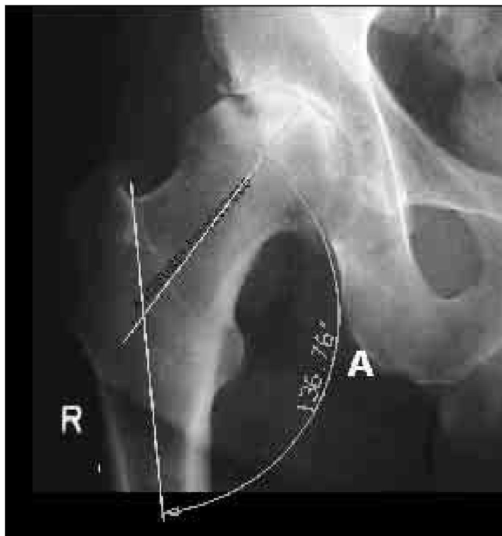

Fig. 2 - *Preoperative angle of femoral neck.*

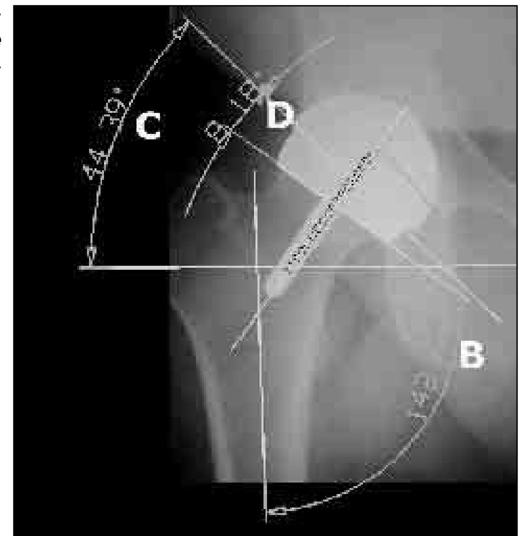

Fig. 3 - *Postoperative measurements.*

special threaded screws. The femoral component is cemented with Simplex antibiotic cement (Stryker Howmedica) on the femoral head. The metal-on-metal chrome cobalt design has a high carbide concentration which corresponds with the old McKee Farrar and Ring prostheses. The cup ranges in size from 44 to 66 mm and the head from 38 to 58mm. Each head size corresponds with two cup sizes. (e.g. 50 head with 56 or 58 mm cup).

A cup position of no more than 45 degrees of abduction and an anatomical anteversion was aimed for. The femoral head was placed in a slight valgus position to the femoral neck. All these angles on the preoperative and postoperative x-rays were measured and registered (measurement on digitalised radiographs, standing pelvis, Siemens Endomap).

On digitalised x-rays 5 measurements were done to evaluate the reproducibility of placement of the BHR prosthesis.

The preoperative angle of the femoral neck was measured (A) (Fig. 2). The postoperative angle of the head of the prosthesis was measured in relation to the shaft of the femur (B). The obtained result and the difference with the preoperative neck-shaft angle were determined.

The abduction angle of the acetabular component was measured (C). The parallelism with the femoral component was looked for and the angle was measured (D) (Fig. 3).

All possible indications were included in our series. Only osteoporosis and nonactive patients were excluded.

Data were collected intraoperatively and postoperatively in a prospective way. Data storage and processing was done using the Orthowave and Statwave software (CRDA Epinet France).

Preoperative scores were not collected since no patients had an arthroplasty when the Harris Hip Score was higher than 50.

Intraoperative and postoperative problems and complications were carefully noted. Reoperations and revisions were reported.

RESULTS

Of the 310 BHR implanted between September 1998 and February 2002, the first 200 patients were reviewed with a follow-up from 6 months to 3.5 years. Only two patients were lost to follow-up because they had died.

Preoperative diagnoses are shown in Table I.

Age at surgery ranged from 16 to 75 years, with a mean of 49.5 years. The mean weight was 81.6 kg (44-123 kg, SD 18). BMI averaged 27 (18.8-42.1 SD 4.3). Left: right distribution was equal (52.9 and 47.2, respectively). More male patients were treated than female, (male 70.3, female 29.7) This was partially due to the better bone stock and less osteoporosis in men.

94.7% were Charnley Group A, 1.6% Group B and 3.7% Group C. The maximum duration of follow-up

was 3.5 years, but the mean for the group is 1.01 year (SD 0.6).

Ten cases were bilateral. In 182 cases a normal BHR was used, in 18 cases a Dysplasia BHR (Fig. 4).

Length of surgery and blood loss are similar to a classical total arthroplasty procedure (Tab. II).

The femoral and acetabular sizes utilised are shown in Figure 5.

The mean length of stay was 6.9 days (2-25 days, SD 3.5). Currently, this is 4.3 days.

At the most recent follow-up 97.5% of the cases had no pain. The total Harris Hip Score averaged 97.24 (41-100, SD 7.6). The mean Postel Merle d'Aubigne score was 17.3 (6-18, SD 1.6). Seventy-two of the patients performed strenuous activities.

Hip flexion averaged 120.36 degrees (range 90-140). Hip flexion in the early postoperative rehabilitation sometimes progresses only slowly, but with time it becomes almost normal.

Complications and reoperations are outlined in Tables IV and V.

The complications are summarized as "not related" to the resurfacing procedure itself and especially related to this procedure.

The two intraoperative fissures of the acetabulum united uneventfully. The rehabilitation program with immediate full weightbearing one day postoperatively was not changed.

TABLE I - AETIOLOGY

	Indications
Osteoarthritis	80.54
Necrosis	8.95
Rheumatoid	3.11
Traumatic	1.17
Neuro-metabolic	0.39
CDH	4.28

Ischial nerve palsy occurred in a patient with spondylolisthesis of the L5S1 space and did not fully recover.

The postoperative deep vein thrombosis and pulmonary embolism were treated with anticoagulants without complications.

To obtain a good fit and seating of the acetabular component, a heavy hammer should be used (1kg). The heterotopic bone formation was asymptomatic. In every patient prophylactic indomethacin was given for 3 weeks, in risk patients (ankylosing spondylitis, posttraumatic cases) a single irradiation dose of 700 Rad was given.

The femoral neck fracture occurred 3 weeks after surgery in a 42-year-old male patient with cerebral palsy and muscular spasticity. A difficult reduction in this CDH case and osteoporosis must have led to an intraoperative stress fracture of the neck of femur. A re-operation was done with a modular head on a cemented stem (Fig. 6).

A guide pin used in the resurfacing procedure, was inadvertently left *in situ*. It was not removed, and is still in place 2 years later.

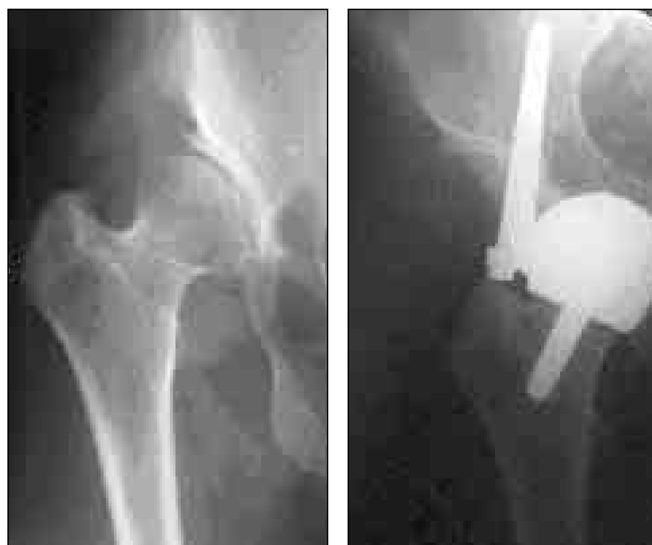

Fig. 4 - *Dysplasia BHR in CDH.*

TABLE II - BLOOD LOSS AND OPERATING TIME

	Surgery details		
	Mean	Range	SD
Blood loss	466 ml	250 – 1500	218
Operating time	96 min (skin to skin)	45 – 240	27

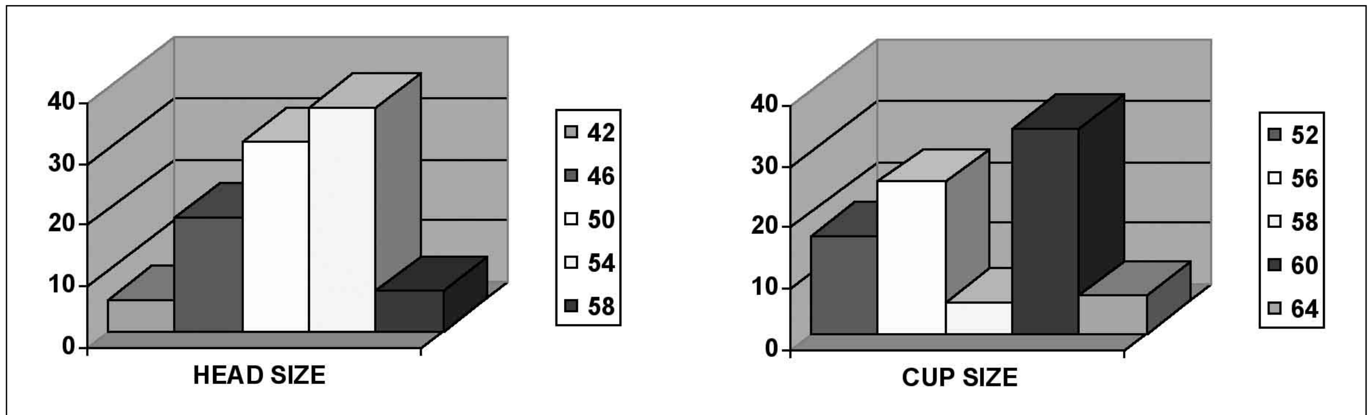

Fig. 5 - *Most utilised sizes of BHR head and cup (mm).*

TABLE III - HARRIS HIP SCORE AND PMA SCORE AT FOLLOW-UP

	HHS	PMA
Excellent	66.88 %	78.34 %
Good	30.57 %	16.56 %
Fair	1.27 %	3.18 %
Poor	1.27 %	1.91 %

TABLE IV - COMPLICATIONS AND REOPERATIONS NOT RELATED TO THE PROCEDURE

Complications (n=7)	
Intraoperative acetabular fissure	2
Ischial nerve palsy	1
DVT (lesion to femoral vein)	1
PE	1
Cup not deep enough	1
Heterotopic ossification Brooker grade 1	2

TABLE V - COMPLICATIONS RELATED TO THE PROCEDURE

Complications (n=2)	
Fractured neck of femur	1
Pin in femur	1

There were no deep infections, no dislocations, and no clear evidence of leg lengthening (mean 0.07 cm).

The measurements on the digitalised x-rays are shown in Table VI.

The measurements were done on 115 resurfacings. We can conclude that with the BHR instruments and good preoperative templating the technique is very reproducible.

There is a significant cross-correlation (0.001) between the preoperative angle of the femoral neck and the postoperative angle of the femoral head component, where a slight valgus position should be maintained (mean of + 2.9 degrees).

The patient with the minimum of the valgus/varus positioning (difference preoperative/postoperative angle) (-11) has a severe valgus neck of 148 degrees that was placed in varus with a postoperative angle of the head component of 137 degrees.

The patient with the maximum of the valgus/varus positioning (+ 29), is a patient with a varus femoral neck of 113 degrees, which was placed in 137 degrees postoperatively.

The mean abduction angle of the cup is 46.4 degrees. In dysplasia cases it is lower (mean 38.1 degrees).

The angle between cup and head (D) is not significantly correlated with the cup position, head position, preoperative angle of femoral neck and valgus positioning of the head.

When the head component has been placed in varus relative to the preoperative femoral neck there is a significant correlation (0.01) with the cup/head angle. Varus

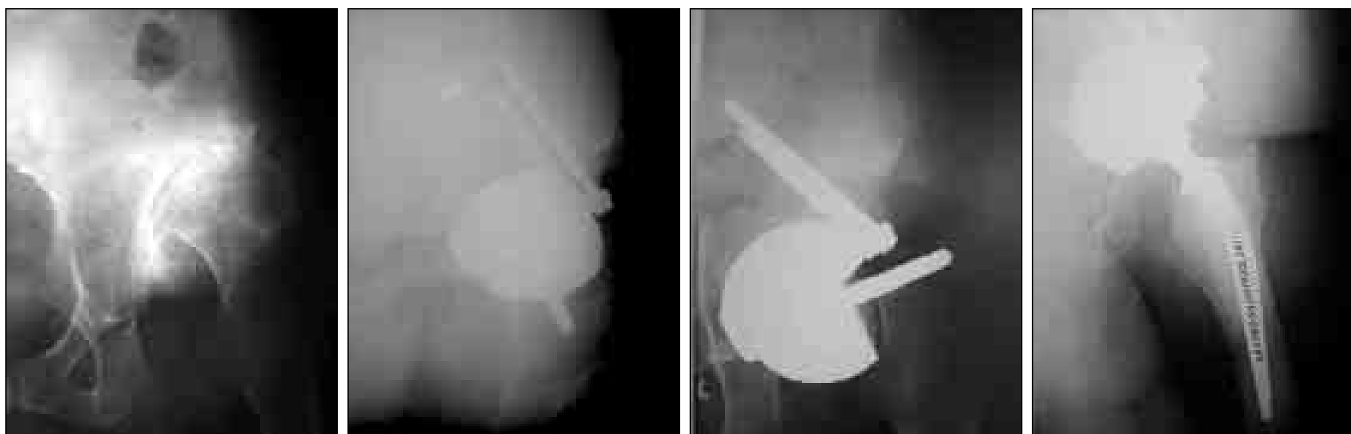

Fig. 6 - *Complication associated with fractured neck of femur.*

TABLE VI - PREOPERATIVE AND POSTOPERATIVE MEASUREMENTS

	Mean (degrees)	Range	SD
Preoperative angle of femoral neck (A)	134.9	113 – 148	6.8
Postoperative angle of femoral head	137.6	125 – 156	5.9
Valgus (+) or varus (-) positioning of head in comparison to preoperative angle (B)	2.9	(-11) – (+24)	6.1
Abduction angle of acetabular component (C)	46.4	29 – 61	6.7
Parallelism acetabular/femoral component (D)	- 7.3 (angle open laterally)	(-33) – (+16)	8.8

positioning of the head has a major influence on the final position and parallelism of head and cup component.

In the future cross-correlations will be made to determine if the placement of the prosthesis plays a role in the long-term clinical or radiological outcome. Today there are no problems.

DISCUSSION

The early clinical and radiological results in this group of metal-on-metal resurfacing are very satisfactory with Harris and PMA scores indicating early clinical success. The high percentage of strenuous activity in this young patient group satisfies the expectations of the resurfacing, notably anatomical restoration, with restoration of leg length and offset. A faster recovery and shorter hospital stays are becoming standard with this procedure. The absence of dislocation in our series corresponds with the scientific studies done on larger bal heads and dislocation.

A femoral neck fracture can in our philosophy only occur with a poor technique or improper indications (elderly people – osteoporosis).

CONCLUSION

Using only alternate bearings in patients under the age of 75, the metal-on-metal Birmingham hip resurfacing appears to be a good alternative in young active patients and the results are promising.

Meticulous surgical technique is a key to a good postoperative and long-term result.

Proper preoperative templating and reproducible placement of the prosthesis components, together with surgical skill can result in an excellent outcome for the patient without any restrictions in activities.

The metal-on-metal bearing should guarantee a low-wear result without osteolysis.